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The prevalence of thyroid nodules among Saudi radiography technicians

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ABSTRACT

Background and Objectives: Exposure to radiation is more likely to develop thyroid nodules. Radiography technicians are exposed to radiation. This study compares the prevalence of thyroid nodules among Saudi radiographic technicians compared to other health professions not exposed to radiation. *Methods:* A case-control study was conducted to determine thyroid nodules among Saudi radiographic technicians. The case and control groups included 200 and 710 individuals, respectively. Participants were interviewed and given a questionnaire about their past exposure to radiation and subjected to a thyroid gland ultrasound scan after giving written permission to participate in the study. *Results:* Thyroid nodules were recorded in 34% of cases and 9% of controls. Females outnumber male thyroid nodules by a factor of two for both groups. Thyroid nodules were more common in those over 45 in both groups. The study recorded thyroid nodules in the case group in association with the long duration of exposure to radiation (P. value < 0.05) whereas no such difference was reported in the controls. The two groups had varied numbers of thyroid nodules. The case group had more thyroid nodules. Single echo abnormalities were seen in 41.8% of cases, numerous anomalies in 20.5%, and diffuse anomalies in 38.2%. The research showed a link between age and thyroid nodules in both groups (P 0.05). *Conclusion:* The research discovered significant evidence that chronic low-dose radiation exposure may increase thyroid nodules. When radiographic technicians deal with radiation, they must adhere to safety precautions.

Keywords: Thyroid Nodules, Radiography Technicians, Radiation Exposure

1. INTRODUCTION

Thyroid nodules are distinct from the thyroid gland. These nodules are often discovered by chance during computer tomography CT and magnetic resonance imaging MRI (Frates et al., 2005). Ultrasound testing is sometimes suggested in the general population for incidental thyroid nodules. Safe and quick, ultrasound is a great option for medical diagnostics. Due to its sensitivity to thyroid nodules, it has the potential to assist in future research and treatment decisions (Xie et al., 2016). Around 3% to 7% of thyroid nodules identified by ultrasonography are cancerous (Jemal et al., 2005). The reported incidence of nodular thyroid disease varies considerably depending on the

sample population and the nodule detection method employed. Nodules become more prevalent as people age, and their prevalence is greater in women, those with iodine deficiency, and those exposed to radiation (Dean and Gharib, 2008; Elzaki et al., 2012; El-Wafa et al. 2020).

Ultrasonography is the imaging technique of choice for thyroid nodules. It is capable of detecting nodules that are too small to palpate, numerous nodules, central or lateral neck lymphadenopathy, and precise nodule diameter measures for interval monitoring (Papini et al., 2002; Fish et al., 2008; Raslan et al. 2020). Thyroid nodules are best evaluated and monitored with ultrasonography, which is both accurate and cost-effective. Ultrasonography equipment available today is reasonably priced, sensitive, and easy to use. The majority of endocrinologists currently utilize ultrasonography to evaluate patients with a confirmed or suspected thyroid nodule (Dean and Gharib, 2008).

Despite the fact that the link between thyroid cancer and radiation exposure is widely known, the question of whether all irradiated individuals should have thyroid ultrasounds remains unclear. Thyroid nodules are common in irradiated individuals. Numerous additional ones may be identified throughout time, although most of them are small and detectable because of the increased resolution of ultrasound equipment. Thyroid hormone-treated individuals' nodules seemed to regress in comparison to non-treated patients. Due to the impossibility of doing a Fine Needle Aspiration FNA on all thyroid nodules in irradiated individuals, ultrasonography may be used to detect those that are growing (Mihailescu et al., 2005). High dose ionizing radiation exposure, especially in children and adolescents, has been linked with an increased risk of thyroid and short-term nodular cancer (De Groot et al., 1983; Shore et al., 1976; UNSCEAR, 1972; Kingman, 1992; Boice et al., 1992). External radiation used to treat benign diseases in the head and neck area increases the incidence of thyroid cancer in exposed individuals (Hatipoglu et al., 2000). Several studies have been published on long-term, environmental, or occupational low-dose exposure (Wang et al., 1990; Andersson et al., 1991; Kendall et al., 1992).

Objectives of the study

The study compares the prevalence of thyroid nodules among Saudi radiography technicians exposed to radiation in hospitals subjected to a relatively low dose, continuous dose, or fractionated ionizing radiation to other health professions no exposed to radiation, using ultrasonography

2. MATERIALS AND METHODS

Between January and August 2020, this case-control study used ultrasonography to determine the prevalence of thyroid nodules among Saudi radiography technicians working in Saudi Arabia hospitals. A random sample of two hundred Saudi radiography technicians working in various x-ray departments was taken. According to their yearly exposure records, all participants were exposed to ionizing radiation but did not exceed the allowed annual dosage of "5 rem." The survey included all individuals who had more than 10 years of occupational exposure to x-rays; those with fewer than ten years were omitted. The researchers selected ten years since previous studies have shown that the mean latency period for comparing thyroid disease after first radiation exposure is more than ten years (De Groot et al., 1983; Shore et al., 1976; UNSCEAR, 1972); often, because an effective cumulative dosage is typically long enough to accomplish.

The individuals were classified according to their age, gender, and years of radiation exposure. Each participant's neck was scanned utilizing the direct contact method for real-time thyroid ultrasonography. The thyroid gland's size, location, symmetry, nodularity, texture, and echogenicity were all reported appropriately. SPSS13 was used to analyze the collected data. Chi-square and independent sample t-tests were used (SPSS Inc., Chicago, IL, United States of America). A test was applied to data to detect significant differences between different groups. Differences were considered significant at ($P < 0.05$).

The study's results on the prevalence of nodules among Saudi radiography technicians were compared to those of another study, which utilized an adult Saudi population with no exposure as a control group and was selected using a cluster random sampling method. The two study groups were matched for gender and age .The findings were compared to those of previous research, particularly those performed in recognized regions of iodine deficiency globally .The respondents were fully informed of the study's objectives, and permission was acquired from (The Hospital director) to conduct the research; it was performed in accordance with the 2000 revision of the Declaration of Helsinki.

All survey participants' right to confidentiality and anonymity was carefully considered. To maintain participant anonymity, a unique number was assigned to each survey respondent. This number was used to connect the survey data to the respondents. Furthermore, secrecy was maintained since only the researcher had access to the gathered data. Each participant received the same number and kind of ultrasounds, ensuring their equality under the law. Treating all participants equally while, providing them

with a chance to participate in the survey allowed us to observe justice and human dignity. Participants may opt in or out of the activity at any time. The participant was given informed consent that will be signed after explaining the purpose, possible outcomes of the survey, and conditions applying to their participation. Before data collected ethical approval number: LEC 72/2019 was done from the local ethics committee of the College of Applied Medical Sciences, Taif University, Saudi Arabia.

3. RESULTS

The case and control groups included 200 and 710 individuals, respectively. The characteristics of both groups are presented in table 1. The data were expressed as mean ± standard deviation SD. The mean age was 39.7 years and thyroid nodules were presented in 34% and 32% of the case group and control group respectively. In addition, the ratio of thyroid nodules between female and male was (2:1) for both groups. Regarding the case group, forty-six (67.6 %) females developed a degree of thyroid nodules compared to males 22 (32.35 %) (Table 2). With a 10-year interval range, the ages of the participants in the case study were split into three groups: A, B, and C (Table 3).

Table 1 The characteristics of case and control groups

	Case Group	**Control Group**
	n= 200	**n = 710**
Age	39.7 ± 7.3	40.1 ± 8.2
Female: Male	2:1	2:1

Table 2 The distribution of thyroid nodules by gender in Saudi radiography technicians (case group)

Gender	**Thyroid nodules**	**Without thyroid nodules**
Male	22(32.35 %)	78
Female	46(67.65 %)	54
Total	68(34.00%)	132

Table 3 The distribution of thyroid nodules by age in Saudi radiographic technician

Age	**Group**	**With thyroid nodules**
≤ 35	A	4 (5.88%)
36-45	B	24 (35.29%)
> 45	C	40 (58.83%)
Total		68

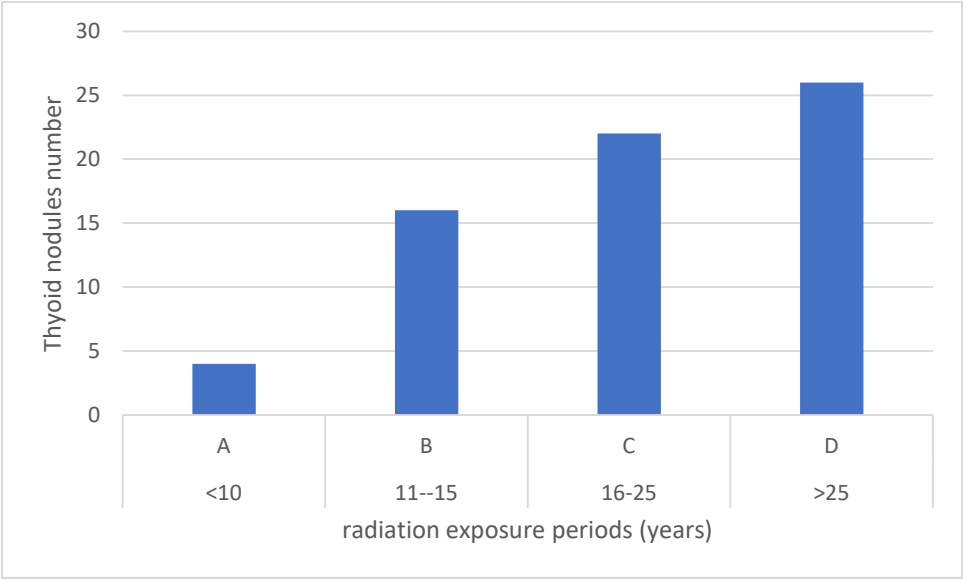

Figure 1 Distribution of thyroid nodules among case group according to period of radiation exposure (years)

In group A, only 4 (5.88%) participants reported a degree of thyroid nodules. Group B showed a marked increase in thyroid nodules 24 (35.29%). Group C revealed the highest prevalence of thyroid nodules, where they formed 40 (58.83%) of the case group.The research showed a statistically significant relationship between age and developing thyroid nodules (P. value < 0.05). The case group was split into four groups with a median age of 5 years: A, B, C, and D. Figure 1 present that thyroid nodule becomes more prevalent over time as exposure to radiation rises. There is a statistically significant correlation between thyroid nodules and length ofexposure to radiation (P = 0.05).

Figure 2 represents the record of thyroid nodules by ultrasound. The thyroid nodules ultrasound abnormalitieswere categorized into of three types of solitary, multiple, and diffuse representing (41.18%, 20.59%, and 38.23%), respectively. There was a statistically insignificant relationship between age and number of thyroid nodules (P. value=0.286).

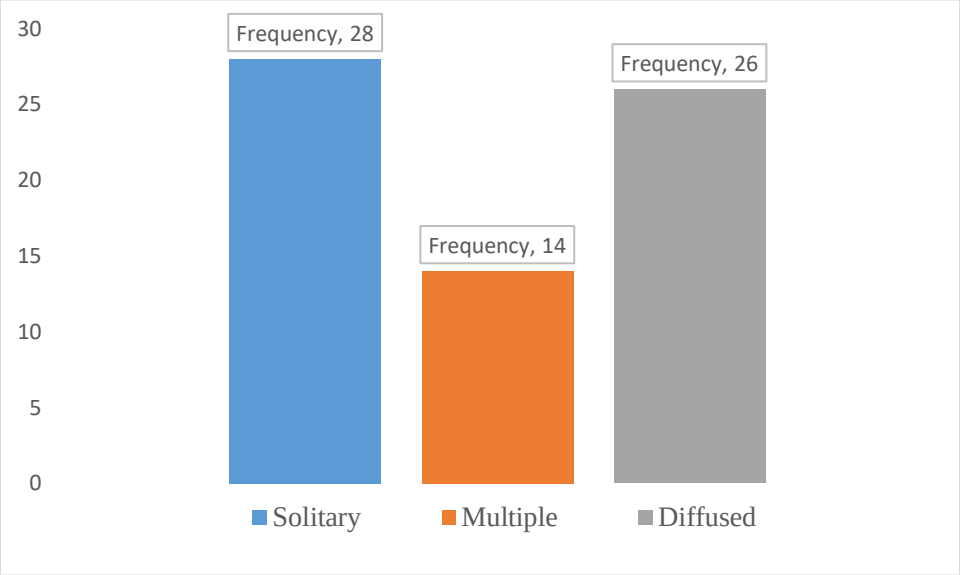

Figure 2 Type of thyroid nodules according to ultrasound findings throughout case group

4. DISCUSSION

The number of Saudi radiographic technicians has been steadily growing over the last 10 years, as more radiography graduates have graduated from various colleges across the country. Thyroid cancer is an uncommon illness, and thyroid nodules are an intermediate endpoint in the evaluation of risk for thyroid cancer, therefore study is required (Sigurdson et al., 2005). The term occupational radiation dose defines the limits of radiation exposure for adult radiation workers and may refer to any combination of the amount of radiation absorbed through external and internal exposure (Al-Abdulsalam and Brindhaban, 2014).

The thyroid's response to long-term low-energy radiation exposure has only been studied in a few studies performed from an occupational viewpoint (Antonelli et al., 1996), and the results are mixed. Few studies have looked at the consequences of long-term, low-dose exposure on long-term exposure, and those studies have been limited in their findings (Boice et al., 1992; Wang et al., 1990; Andersson et al., 1991; Kendall et al., 1992). The majority ofstudies discovered a significant incidence of thyroid cancer and nodules in individuals who had been exposed to radiation on the job (Boice et al., 1992; Wang et al., 1990; Andersson et al., 1991; Kendall et al., 1992). Recent studies have provided significant and essential data indicating that even low dose ionizing radiation exposures may result in a modest increase in the incidence of thyroid nodules (Elzaki et al., 2012), even when the radiation is shielded. The debate over whether ionizing radiation may cause thyroid nodules is currently continuing.

The prevalence of thyroid nodules among Saudi radiography technicians included both males and females were investigated in this research using ultrasonography on a random sample of individuals who had been exposed to radiation at their place of employment for more than 10 years. According to Antonelli et al., (1996) occupational radiation exposure may be a risk factor for thyroid nodules. The number of participants who had thyroid nodules were 68 (34%), which allows us to agree with them. Male to female gender orientation, advanced age (Kingman, 1992), and iodine deficiency (Boice et al., 1992) are all well-known risk factors for thyroid nodules. Male and female educations have been inequitably distributed across Saudi Arabia's development agenda during the last several decades, particularly in the health sciences. This study found 23 (67.65 %) of the total participants to have thyroid nodules, which is nearly identical to the findings of (Boice et al., 1992) in a health survey in the United States who reported that female radiologic technologists with thyroid nodules were more common than male radiologic technologists (76 percent). A

pooled analysis of seven studies conducted by (Ron et al., 1995) discovered that the excess relative risk ERR was higher (P = 0.07) in females than in men (P = 0.07) (Trerotoli et al., 2005) discovered that sex was a major risk factor for the development of thyroid disorders in his research.

The age at which a person is most likely to acquire thyroid nodules is a critical consideration; the prevalence of thyroid nodules rises with age in both men and women (Dean and Gharib, 2008). In the present research, individuals over the age of 45 years had the greatest number of thyroid nodules (20, or 58.83 %); in addition, nodules were statistically more common in those who had had occupational exposure to x-rays for more than 25 years. This research found a statistically significant relationship between thyroid nodules and the length of time spent in the workplace, while Adibi and colleagues (2012) found no association between extended occupational exposure to low radiation doses and the chance of developing thyroid nodules. Numerous investigations have shown that ionizing radiation has adverse effects on the thyroid gland, particularly as a primary cause of thyroid cancer and nodules (Nikiforov, 2010). Acute exposure is more hazardous than chronic exposure, according to an analysis of the risk of the diseases in relation to radiation dosage. High doses of ionizing radiation have a number of negative effects, including the development of cancer. While the situation is less apparent at low radiation doses, the danger of low-dose radiation is critical due to its association with problems as diverse as cancer screening tests and occupational radiation exposure (Gilbert, 2009; Wrixon, 2008).

There is no conclusive evidence linking occupational radiation exposure to thyroid cancer or nodules. According to some earlier studies, thyroid cancer and nodules are prevalent. On a daily basis, employees are exposed to radiation in the workplace. In contrast, some have asserted that it is difficult to attribute nodules or other benign diseases to radiation (Violante et al., 2003; Antonelli et al., 1995; Antonelli et al., 1996; Trerotoli et al., 2005; Inskip et al., 1997). The echo abnormality, which was found to be solitary in 28 subjects (41.18 %), multiple in 14 subjects (20.59%), and diffuse in 26 subjects (38.23 %), corresponds to the thyroid abnormalities discovered by Brander et al., (1991) which were found to be solitary in 39 subjects (57 %), multiple in fifteen subjects (22 %), and diffuse in fifteen subjects (22 %). In a randomly selected adult sample, Brander et al., (1991) discovered that the frequency of minor thyroid echo anomalies is quite high.

5. CONCLUSION

The issue between thyroid nodules and occupational radiation exposure is, however, far from being settled. Additional research with a control group from the same setting and bigger sample numbers is needed, as is consideration of iodine status, thyroid function, and radioisotope scanning. Additional follow-up for Saudi radiographic technologists will help better characterize the risks associated with low-dose-rate exposure to ionizing radiation, a concern for worker radiation protection, and will require them to wear a personal dosimeter throughout the duration of their shifts and use basic radiation protection principles, such as thyroid choler shielding, as radiation protectors.

Author's contributions

First author: planning, set up the research and writing. Second author: data collection, literature and revising as well as submission.

Informed consent

The written and verbal informed consent was obtained from all participants before enrollment in the study.

Ethical approval

The local ethics committee of the College of Applied Medical Sciences, Taif University approved this study (Ethical approval number: LEC 72/2019). The sequence followed was similar to Helsinki Declaration of 1975 which was revised in 2013.

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Conflict of Interest

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are presented in the paper.

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